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WIND POWER PLANTS IN RUSSIA

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16. Abstract

Several measures relative to wind power plants have been taken by the Soviet government, and are outlined. The large Balaklava wind power plant is described briefly. The wind power experimental facility in Moscow is illustrated in a diagram and its operation discussed in some detail.

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Th. Sauer

A directive in Soviet Russia has established systematic /947* production of wind motors, particularly for agricultural operations. A committee of representatives of the Commissariats of Heavy Industry and Agriculture, and representatives of scientific research institutes got the job of working out appropriate construction designs for production in large quantities. They are 1) for water wells up to 30 m deep, 2) up to 100 m deep, 3) up to 120 m deep, and for driving agricultural machinery, and 4) for regions with a mean wind speed over 7 m/sec, to drive generators and for other purposes, including irrigation systems.

As far as the installation of wind power plants, 200 model wind power plants are to be constructed in various regions at the cost of the State. In addition, there is one experimental plant under construction at Rostov with 29 kW power and another in Peressadovka (Ukraine) with 75 kW power. The operating results of these facilities are to provide standards for the further development of wind power plants.

As far as wind power plants of large power, there is a plant in operation at Balaklava on the Crimean Peninsua, 10 km from Sebastopol [1]. It consists of a wind motor of 110 kW maximum power, which is coupled through a toothed-wheel gearing to a 93-kW asynchronous generator. The wind wheel with helical vanes has a diameter of 30 m, and makes 30 rpm. To increase the starting torque and to reduce the power drawn at high wind speeds, the vanes pivot around a fixed strut, and are adjusted automatically by an auxiliary control surface; this arrangement is based on the same fundamental idea as the control of ships'

*Numbers in the margin indicate pagination in the foreign text.

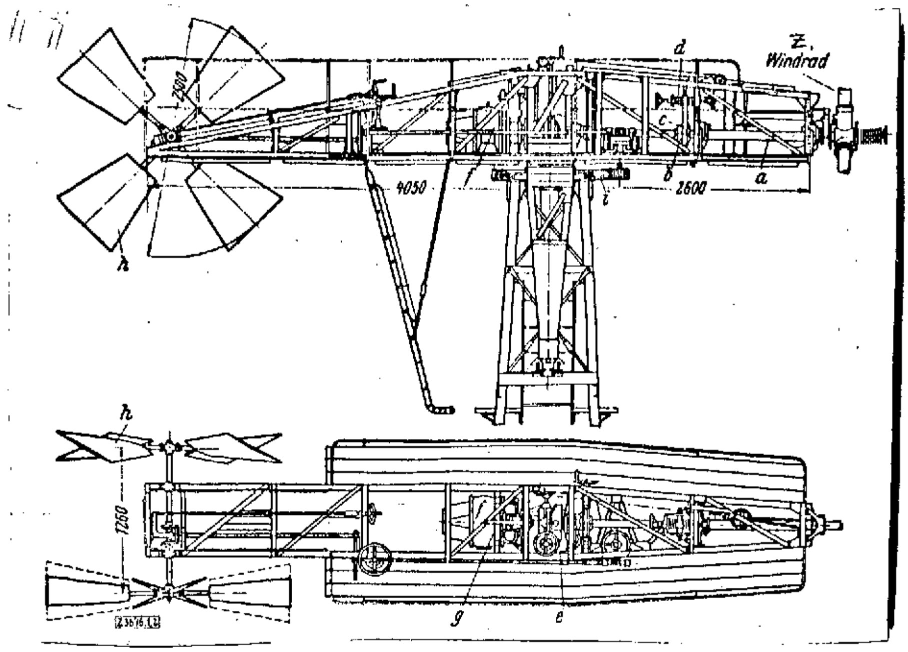
rudders proposed first by Flettner in Germany. The generator for 220 V voltage is equipped with an automatic slip-control resistance. This control is similar to that used in the asynchronous drives of rolling trains. With a 5% overload on the generator, the resistance of the slip control is switched in, until the load reaches 95% of the rated load. The parallel circuit with the Sebastopol network is brought about automatically through a 6300-V transformer and a 2600-m-long trunk line. The power plant has been in operation since 1931, and has withstood without damage several hurricane-type winds with speeds up to 44 m/sec [2]. /498

Based on the experiences with this power plant, the construction of a wind power plant of 10,000 kW at about 20 m/sec wind speed is to be initiated, likewise in the Crimea on the Ai-Petri mountain chain [3, 4]. The design provides for two wind wheels, each 80 m in diameter, where the first wind wheel is 65 m above the ground, and the second, 158 m up. The tower is to be made of reinforced concrete.

Experimental Wind Power Plants

The scientific research important for the construction of wind-powered motors is being conducted in the Wind Power Experimental Facility of the Central Aerohydrodynamic Institute in Moscow [5]. This experimental facility has the job of testing models of wind wheels not in wind tunnels, but instead under the actual wind conditions. It is equipped so that characteristic curves of wind wheels up to 10 m in diameter can be recorded.

The top of the experimental facility is depicted in Figs. 8 and 9. The horizontal main shaft a, which bears the wind wheel, has three bearings, each of which consists of a ball bearing and a friction bearing. The design makes it possible to measure the torque and the longitudinal shear of the shaft.



Figs. 8 and 9. Top of the experimental plant for studying wind wheels.

a Main shaft
b Double ball bearing) for measuring longitudinal shear
c Double lever)
d Double coil spring)
e Sliding sleeve
f Superregenerative direct-current generator
g Double spring for measuring torque
h Control wind vanes
i Gear wheel

Key: z. Wind wheel

The longitudinal shear is transmitted from the double ball bearing b through the double lever c to the double spring d, whose compression is a measure of the shear.

The main shaft is connected on the left end with a sliding sleeve e, through which the torque is transmitted to the superregenerative generator f in such a fashion that the shaft can move freely in the longitudinal direction. The superregenerative direct-current generator together with a toothed-wheel gearing is supported on ball bearings. The torque is measured by the compression of the springs g as the housing revolves. Large variations are attenuated by a damping mechanism. The wind wheel is automatically adjusted to the wind direction by means of the control wind vanes h, whose revolutions are transmitted to the gearwheel i of the tower.

The alternating-current generator has reversing poles, external excitation, and a compound winding which can be reversed. Its power is 4.7 kW at 230 V and 900 to 1200 rpm. This generator feeds a direct-current motor for 5 kW with external excitation. The motor drives an asynchronous alternating-current generator for 200 V. This generator is in parallel with the network. The compound winding makes it possible to keep the wind wheel at an even rate of revolution, regardless of the wind intensity. However, since generator operation becomes unstable with too tight a compound winding, there are shunt resistors in parallel with this winding. Through these resistors, the dependence of the rate of revolution of the wind motor on the wind intensity can be varied.

In the experiments, the torque, the longitudinal shear of the main shaft of the wind wheel, the rate of revolution, and the wind speed are measured. The speed of the wind which strikes the wind wheel is very difficult to measure. In order to keep the wind wheel from influencing the flowmeter readings, and in order to measure wind speed at more than one point, two wind gauges are placed on the extension of the horizontal diameter of the wind wheel, each at a distance of one wind-wheel diameter from the center of the shaft. The mean value of their readings is taken as the mean value of the wind speeds to be measured. Detailed investigations have been conducted with this facility on various wind wheels, including wind wheels with automatically-adjusting wind vanes.

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